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Changes in Ultra-Processed Food Intake During a Single-Arm Behavioral Weight Management Intervention: A Secondary Analysis

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ABSTRACT

Objective: Increasing evidence links ultra-processed food (UPF) intake to obesity and related diseases; however, little is known about the role of UPF in behavioral weight-loss interventions (BWLIs). Thus, the current study investigated whether UPF intake changes during a BWLI and whether these changes are associated with weight-loss outcomes.

Methods: A total of 449 adults with obesity (mean ± SD age = 49.5 ± 11.4 years, BMI = 35.7 ± 4.0 kg/m^2, 83.5% female, 23.4% Black/African American, 9.8% Hispanic) completed a 16-week BWLI. Using dietary intake data collected via the Automated Self-Administered 24-Hour Dietary Assessment Tool (ASA24), we examined (1) changes in caloric intake and the proportion of calories from UPFs from baseline to post-intervention and (2) associations between these changes and weight loss, overall and adjusting for caloric intake.

Results: Participants demonstrated reductions in calorie intake (−461 ± 931 kcal/day), UPF intake (−3.0% ± 2.8% of total energy), and body weight (−7.2 ± 7.6 kg) over the BWLI, $ps < 0.001$. Greater reductions in UPFs were associated with greater decreases in caloric intake ($r = 0.10$) and greater weight loss ($r = 0.08$, $ps < 0.001$), even after adjusting for changes in caloric intake ($p = 0.005$); however, effect sizes were small.

Conclusion: UPF intake decreased during the BWLI, and greater reductions were associated with greater weight loss, independent of caloric changes, though small effect sizes warrant cautious interpretation. Future research should examine whether targeting UPF reduction in a BWLI enhances weight outcomes.

Trial Registration: ClinicalTrials.gov Identifier: NCT04116853.

1 | Introduction

Ultra-processed foods (UPFs) are defined as industrially formulated foods that include additives, preservatives, and other ingredients (e.g., emulsifiers, artificial flavoring) not commonly used in home cooking [1, 2]. UPFs are highly prevalent in Western diets, contributing to over 50% of daily energy consumption among US adults [3, 4]. Concerningly, some evidence suggests that UPFs are associated with addictive-like eating [5, 6], faster rates of eating [7, 8], and greater caloric intake [7, 8]. Habitual UPF consumption has also been associated with an elevated risk of obesity and chronic disease outcomes such as cardiovascular disease, type 2 diabetes, and mortality [9–12].

Behavioral weight management interventions (BWLIs) remain the first-line treatment approach for adults with obesity and typically result in losses of 5%–8% of initial body weight [13]. BWLIs help participants make changes in their eating and exercise habits to reduce caloric intake and increase energy expenditure, facilitated through interventionist support, education on weight-related topics, and behavioral skills training (e.g., training in self-monitoring, goal setting, and problem solving) [14]. Although these interventions focus primarily on helping participants reduce caloric intake, BWLIs also often provide education related to broader nutritional goals (e.g., improving dietary composition and quality) [15, 16]. Given the increasing evidence linking UPFs, caloric intake, and weight status, some BWLIs also now incorporate education regarding UPFs into broader discussions of dietary composition and quality [17–19].

Little is known, however, regarding changes in UPFs within BWLIs and whether these changes are associated with improved weight-loss outcomes. The current study aims to address this gap by investigating changes in UPF intake in 449 adults with obesity enrolled in a 16-week BWLI. Participants were asked to complete dietary recalls and have their weight measured at baseline and post-intervention; using these assessments, it was hypothesized that (1) both total caloric intake and percent of energy from UPFs would significantly decrease from baseline to post-intervention, (2) greater decreases in caloric intake would be significantly associated with greater decreases in UPFs, and (3) greater decreases in both caloric intake and UPF intake would be associated with greater percent weight loss during the BWLI. As an exploratory analysis, we examined (1) whether there were associations between baseline caloric intake, UPF intake, and weight and whether these baseline values were associated with changes during the BWLI and (2) whether greater reductions in UPFs would be associated with greater weight loss after controlling for caloric intake.

2 | Methods

The present study is a secondary analysis of baseline and post-intervention data from Project STAR, a randomized clinical trial that evaluated the effects of an adaptive algorithm on weight-loss maintenance after successful weight loss (ClinicalTrials.gov Identifier: NCT04116853) [20]. Project STAR enrolled 449 adults with obesity (age 18–70 years, BMI 30–45 kg/m^2) who owned a smartphone in a 16-week BWLI; only individuals who lost ≥ 5% of their baseline body weight were then eligible to be randomized into one of two extended-care maintenance programs. The current study only included data from the initial 16-week BWLI, prior to eligibility assessment (and randomization) for the parent maintenance trial. All study procedures were approved by the Institutional Review Board at the University of Florida, and all participants provided written informed consent (both for screening and participation in the weight-loss program).

2.1 | Participants

Full inclusion and exclusion criteria, details regarding recruitment, and a summary of participant baseline and demographic characteristics for the parent BWLI have been published previously [21]. In brief, participants were recruited from North Central Florida using flyers, community outreach, and the University of Florida's Consent2Share Program. Potential participants were excluded if they used weight-loss medications, had a history of bariatric surgery, or had medical conditions that would contraindicate participation in a group-based BWLI. At baseline, participants were an average (mean ± SD) of 49.5 ± 11.4 years old, weighed 99.9 ± 15.2 kg, and had BMI of 35.7 ± 4.0 kg/m^2; 83.5% ($n = 375$) of participants identified as female and, in terms of race, 74.2% ($n = 333$) identified as White, 23.4% ($n = 105$) as Black or African American, 3.1% ($n = 14$) as Asian, 2.0% ($n = 9$) as American Indian, Alaskan Native, Native Hawaiian, or other Pacific Islander, and 1.1% ($n = 5$) did not report a race (categories may add up to more than 100% as participants could select all categories that applied). In terms of ethnicity, 9.8% ($n = 44$) identified as Hispanic or Latino. In terms of income, 3.8% of participants reported annual household incomes below $25,000; 19.2% reported $25,001–$50,000; 22.3% reported $50,001–$75,000; 16.5% reported $75,001–$100,000; 14.3% reported $100,001–$125,000; and 21.6% reported $125,001 or more (2.4% unreported). Education levels ranged from high school to graduate/professional degrees, with the largest proportions reporting a college degree (29.4%) or a graduate/professional degree (39.0%).

2.2 | Intervention

The intervention protocol was published previously [19]. In brief, all participants received a 16-week, gold-standard BWLI adapted from the Diabetes Prevention Program (DPP) [15], with adaptations focused on updating session material and topics to reflect up-to-date research on weight management (e.g., the fat gram goal was removed in service of research showing that the type of diet, in relation to macronutrient composition, is less important for weight loss compared to reductions in caloric intake and individuals' ability to adhere to dietary changes). The BWLI used calorie restriction and, during the first session, participants were provided with caloric intake goals (1200–1800 kcal/day based on their baseline weight) and were taught how to self-monitor dietary intake using a no-cost commercial smartphone application (FatSecret Inc.) [22]. The program did not use meal replacements. Participants were also provided with a study e-scale (BodyTrace Inc.) [23] and encouraged to self-monitor their dietary intake and weight each day of the intervention. Starting at Session 5, physical activity goals were introduced and participants were also encouraged to self-monitor physical activity daily.

Although a primary focus of intervention was helping participants meet their caloric intake goal, additional intervention content focused on dietary changes that could help support success at achieving caloric intake goals, presented to participants in a "toolbox approach" (e.g., offering a range tools that may be helpful or not for different individuals, allowing participants to find strategies that work best for them). For example, in the second session participants were taught about energy balance and how expending more calories than they consume leads to weight loss. During this session, it was noted that "a calorie is a calorie regardless" of its source (e.g., regardless of a food or drink's macronutrient content). However, interventionists also noted that some foods may better support satiety and efforts to meet caloric intake goals (e.g., foods with lower caloric density, those with higher fiber and/or protein content). This included a brief discussion of how certain foods, such as UPFs and foods with high sugar and fat content, may be more calorically dense and less conducive to weight loss. Strategies for portion control of these foods were discussed. However, reducing UPFs was not a specific or explicit intervention target. In the fourth session, food groups and overall nutritional balance were discussed, yet without a specific focus on UPFs; rather, discussion focused on US Department of Agriculture (USDA) "MyPlate" dietary intake recommendations [24].

2.3 | Measures

Participants completed assessments at baseline and after the end of the 16-week BWLI [20]. Weight was assessed using the study-provided BodyTrace e-scales, which used the cellular network to transmit weight data to a secure online platform accessible to the research team. Previous research has demonstrated that BodyTrace e-scales have high concordance with in-person weights assessed via research-grade scales [25, 26]. Dietary intake was assessed using the online Automated Self-Administered 24-Hour Dietary Assessment Tool (ASA24), which used the USDA's Food and Nutrient Database for Dietary Studies (FNDDS) to convert reported foods and beverages into estimates of daily energy and nutrient intake [27, 28], with participants asked to complete three nonconsecutive 24-h dietary recalls (two representing weekday intake and one representing weekend day intake) at each assessment point.

UPF intake was classified from the foods and beverages recorded via the ASA24, using the NOVA system [29] and the reference approach developed by Martínez Steele and colleagues [30, 31]. Classification was fully automated and based on published decision rules [30, 31], with no manual coding of individual food items. This method applies a systematic, rule-based algorithm to assign each FNDDS code to one of the four NOVA groups based on published criteria describing the extent and purpose of industrial processing as follows: (1) unprocessed or minimally processed foods, (2) processed culinary ingredients, (3) processed foods, or (4) UPFs. For homemade items or disaggregated codes, underlying standard reference ingredient codes were used when available, with adjustments made for moisture and fat content to ensure that nutrient totals matched parent FNDDS codes [32]. For example, if a participant reported eating a homemade lasagna, individual ingredient codes (e.g., pasta, tomato sauce, cheese) from the USDA standard reference were used, and adjustments were applied to account for moisture loss during baking and fat content from cheese, ensuring that the final nutrient totals aligned with the parent FNDDS lasagna code. Because the NOVA assignments relied on prespecified and established mapping rather than human classification, no coder reliability procedures were necessary [30, 31]. Foods containing industrial formulations with added sugars, fats, flavorings, preservatives, or other cosmetic additives (e.g., packaged snacks, sweetened beverages, ready-to-eat meals) were classified as UPFs.

2.4 | Data Analysis

Statistical analyses were conducted using R version 4.4.3. Missing data from the post-intervention assessment were handled via multiple imputation (MI), using the Multivariate Imputation by Chained Equations (mice) package, using the predictive mean matching method (PMM). PMM is a popular, robust method for handling non-normal missing data including bounded and proportional data [33]. Results reflect pooled results across 20 imputed datasets.

The proportion of energy intake from UPFs was calculated using the mean proportion method [31], defined as percentage of total daily kilocalories derived from UPFs = (kilocalories from UPFs ÷ total kilocalories). All analyses examining "change in UPF intake" therefore used percent kilocalories from UPFs, not absolute kilocalories or grams. Descriptive statistics were used to characterize caloric intake, UPF consumption, and weight at baseline and post-intervention. Paired samples *t*-tests were used to test whether caloric intake and UPF consumption decreased from baseline to Month 4. Next, Pearson's correlation coefficients were used to examine (1) associations between changes in calorie intake, UPF consumption, and weight loss during the BWLI and (2) associations between baseline UPFs, caloric consumption, and weight and whether these values predicted change during the BWLI. Finally, a hierarchical linear regression was used to examine whether changes in UPF intake were associated with weight loss from baseline to post-intervention, after controlling for calorie intake. Multicollinearity was assessed using variance inflation factors (VIF), all of which were below two, indicating no concerns.

As further post hoc exploratory analyses, hierarchical linear regression was used to examine the association between baseline UPF intake (expressed as the percentage of total daily kilocalories derived from UPFs) and percent weight change (after controlling for baseline caloric intake) and whether groups defined by different reductions in UPF intake showed differences in weight change. For this purpose, participants were classified into four categories based on percent change in UPF percent-kcal from baseline: (1) "No Change" (within ±10% of baseline), (2) "Increase" (> 10% increase), (3) "Moderate Reduction" (10%–25% decrease), and (4) "Large Reduction" (> 25% decrease), and participant characteristics at baseline and post-intervention were described for each group.

3 | Results

At the post-intervention assessment, 6.7% of participants ($n = 30$) did not have a recorded assessment weight. Moreover, 8.0% ($n = 36$) did not complete any ASA24 recalls, 2.7% ($n = 12$) completed only one recall, and 0.9% ($n = 4$) completed only two recalls. Table 1 provides MI-pooled average caloric intake, UPF intake (kcal/day and percent of energy), and weight at each time point. Participants lost an average of 7.16 ± 7.57 kg during the BWLI, $t(448) = 60.16$, $p < 0.001$, Cohen's $d = 0.95$, representing a change of −6.99% ± 6.68% from baseline weight. Caloric intake decreased from baseline to post-intervention by an average of 461 ± 931 kcal/day, $t(448) = 31.46$, $p < 0.001$, $d = 0.49$. Finally, participants experienced an average reduction of −3.0% ± 2.8% in the proportion of calories consumed from UPFs, $t(448) = 5.85$, $p < 0.001$, $d = 0.09$. This corresponds to an average reduction of about 285 ± 771 kcal/day, $t(448) = 7.83$, $p < 0.001$, $d = 0.37$.

Table 2 displays correlations between caloric intake, UPF intake, and weight at baseline and change in these variables during the BWLI. Greater reductions in caloric intake were associated with greater reductions in UPF intake, and greater reductions in both were independently associated with greater weight loss. Moreover, at baseline, there were significant associations between caloric intake, UPF intake, and weight, such that higher caloric intake was associated with a higher proportion of UPF intake, and both were associated with higher weight.

TABLE 1 | Average calorie intake (kcal/day), ultra-processed food (UPF) intake (kcal/day and % of total energy), and weight (kg) at baseline and following the end of a 16-week behavioral weight-loss intervention.

	Baseline		Post-intervention	
	Mean	**SD**	**Mean**	**SD**
Caloric intake, kcal	2045	878	1584	583
UPF intake, kcal	1094	688	809	492
UPF intake, % of kcal	0.53	0.22	0.50	0.22
Weight, kg	99.88	15.18	92.72	14.43

Finally, higher baseline weight predicted greater weight loss; both higher caloric intake and higher UPF intake at baseline predicted greater reductions in caloric intake, UPF intake, and weight during the BWLI. As shown in Figure 1 and Table 2, associations between UPF intake and percent weight change were small in magnitude.

Hierarchical regression results demonstrated that, after controlling for change in calorie intake during the BWLI, change in percent calories of UPF intake remained significantly associated with percent weight change, $B=1.57$, $SE=0.50$, $\beta=0.07$, $\Delta R^2=0.005$, $p=0.005$. Specifically, every 0.1 point (i.e., 10%) decrease in UPF intake during the BWLI was associated with a 0.16% greater decrease in weight. Similarly, after controlling for baseline calorie intake, baseline UPF intake remained a significant predictor of percent weight loss, $B=1.35$, $SE=0.48$, $\beta=0.08$, $p=0.005$, such that each 0.1 decrease in UPF intake was associated with a 0.13% greater decrease in weight.

Table 3 presents demographic characteristics of participants across UPF intake groups. Almost half (45.2%) of participants demonstrated moderate (19.8%) or large (25.4%) reductions in UPF intake; 22.5% demonstrated little to no change, and 32.3% increased their UPF intake. Descriptively, participants who had the largest reductions in UPFs were older; however, there did

TABLE 2 | MI-pooled associations between baseline variables and change scores from baseline to post-intervention.

	1	2	3	4	5	6
1. Weight (baseline)	—					
2. Caloric intake (baseline)	0.24*	—				
3. UPF intake (baseline)	0.10*	0.08*	—			
4. Percent weight (change)	−0.18*	−0.09*	−0.03*	—		
5. KCAL (change)	−0.08*	−0.79*	−0.07*	0.09*	—	
6. UPF (change)	−0.05*	−0.05*	−0.64*	0.08*	0.10*	—

*$p<0.01$.

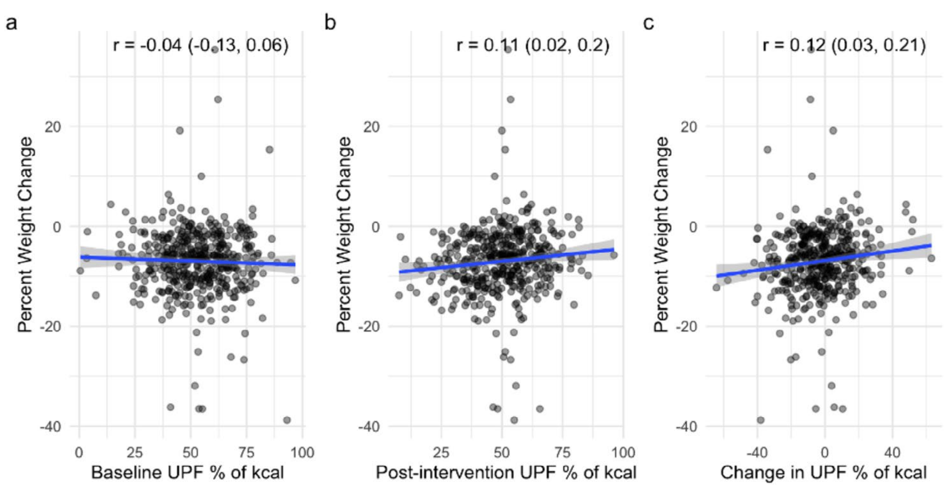

FIGURE 1 | Correlation analyses between percent weight change and (a) baseline UPF % of kcal, (b) post-intervention UPF % of kcal, and (c) change in UPF % of kcal. Each point represents one participant (pooled across imputations). The 95% confidence intervals are presented in parentheses after the reported correlation coefficients.

TABLE 3 | Participant characteristics of categories of change in ultra-processed food (UPF) intake during a behavioral weight-loss program.

	Change in UPF intake			
	Increase (>10% of baseline intake)	**No change (within ±10% of baseline intake)**	**Moderate reduction (10%–25% reduction of baseline intake)**	**Large reduction (>25% reduction of baseline intake)**
n	145	101	89	114
Age; mean ± SD	47.8 ± 12.1	49.0 ± 10.9	51.2 ± 10.2	50.7 ± 11.5
Gender; *n* (%)				
Male	23 (15.9%)	13 (12.9%)	16 (18.0%)	22 (19.3%)
Female	122 (84.1%)	88 (87.1%)	73 (82.0%)	92 (80.7%)
Race; *n* (%)				
White	106 (73.1%)	75 (74.3%)	70 (78.7%)	82 (71.9%)
Black	33 (22.8%)	23 (22.8%)	18 (20.2%)	31 (27.2%)
Native	3 (2.1%)	0	1 (1.1%)	3 (2.6%)
Asian	9 (6.2%)	2 (2.0%)	1 (1.1%)	2 (1.8%)
Pacific Islander	1 (0.7%)	0	0	1 (0.9%)
Other	1 (0.7%)	2 (2.0%)	1 (1.1%)	1 (0.9%)
Hispanic/LatinX; *n* (%)	15 (10.3%)	11 (10.9%)	3 (3.4%)	15 (13.2%)
Education; *n* (%)				
High school or less	6 (3.8%)	4 (4.3%)	3 (4.0%)	3 (3.0%)
Vocational/some college	22 (15.4%)	16 (15.9%)	12 (13.4%)	20 (17.3%)
Associate's (2 years)	19 (13.0%)	13 (12.8%)	11 (12.5%)	13 (11.1%)
College (4 years)	42 (29.3%)	33 (32.3%)	26 (28.8%)	33 (28.7%)
Graduate/professional	56 (38.5%)	35 (34.8%)	37 (41.3%)	45 (40.0%)
UPF intake (% kcal)				
Baseline	0.4 ± 0.2	0.6 ± 0.2	0.6 ± 0.2	0.6 ± 0.2
Month 4	0.6 ± 0.2	0.6 ± 0.2	0.5 ± 0.1	0.3 ± 0.1
Change	0.2 ± 0.2	0 ± 0	−0.1 ± 0	−0.3 ± 0.2

not appear to be notable differences between groups in terms of sex, race, or education. The lowest baseline UPF intake was reported by participants in the "Increase" category, followed by those in the "No Change" category; baseline UPF intake was similar across the "Moderate Reduction" and "Large Reduction" groups. At Month 4, the lowest UPF intake was seen in the "Large Reduction" group, with similar UPF intake reported in the "Increase" and "No Change" groups (see Table 3 for values).

4 | Discussion

The current study examined whether UPF consumption changed during a BWLI and whether these changes were associated with weight loss, independently and after controlling for overall change in caloric intake. From baseline to post-intervention, participants demonstrated significant decreases in caloric intake, the proportion of calories consumed from UPFs, and weight. Importantly, larger decreases in UPF consumption were associated with larger weight loss during the BWLI, even after controlling for changes in total caloric intake. Although this association remained significant, the effect sizes were small, and UPF reductions explained only a modest proportion of the variance in weight change.

Taken together with previous literature linking greater UPF intake with faster eating [5, 6], greater caloric intake [7, 8], and heightened risk of obesity [7, 8], results from the current study provide further support to the broader hypothesis that UPFs may play an important role in weight regulation. A common criticism in the literature is that reductions in UPFs may simply serve as a proxy for reductions in caloric intake, as many UPFs are higher in sugar, fat, and refined carbohydrates [8]. Results from the current study, however, demonstrated that changes in UPF intake remained significantly positively associated with weight loss after controlling for changes in caloric intake, raising the possibility that factors associated with UPF consumption could relate to weight change through pathways other than caloric intake. Although this study was not designed to assess these other mechanisms, other research has suggested that UPFs may be associated with endocrine alterations (e.g., lower PYY and GLP-1 levels [8], lower postprandial leptin levels [7]), increased inflammation (e.g., low-grade gut inflammation linked to UPF additives [34]) and gut-microbiome dysbiosis (e.g., emulsifiers disturb gut microbiota and weaken the intestinal barrier, promoting “leaky gut” and metabolic dysfunction [34, 35]), which influence energy homeostasis and fat storage. However, the present study was not able to investigate these potential mechanisms. These pathways are distinct from indirect behavioral mechanisms such as faster eating rate [7, 8] and increased calorie intake [7, 8], underscoring the complexity of UPF-related weight regulation and making UPFs an important potential target for a future BWLI, particularly in populations with high UPF consumption.

Results also demonstrate that a BWLI (even with only limited education related to dietary quality and the role of UPFs in satiety) may be able to produce reductions in UPFs (in this study, participants reduced UPF intake by 3%, from 53% at baseline to 50% post-intervention). Most interventions emphasize calorie reductions without explicitly addressing UPFs; however, participants in this study achieved these UPF reductions with only brief education (e.g., discussions regarding how UPFs may affect satiety). As this study had no control group (i.e., all participants received the BWLI), and no other BWLI studies have yet reported whether their participants also demonstrated changes in BWLI intake, it is unclear whether the additions to the session materials or even the broader media (and social media) discussions around UPF intake may have had an impact on participant behavior. Future studies should investigate whether intervention strategies targeted specifically at UPF intake (e.g., additional education about UPFs, specific skills around label reading or strategies for swapping UPFs with less processed alternatives) can lead to greater reductions in UPF intake and improve weight-loss outcomes.

Finally, results demonstrated that higher UPF intake at baseline was associated with higher caloric intake at baseline and furthermore that (1) higher baseline UPF intake predicted greater reductions in UPF intake and (2) higher baseline caloric intake predicted greater reductions in caloric intake. It may be that individuals with greater UPF intake, like those with higher caloric intake, have more “room to change” once engaged in a BWLI. The fact that even at post-intervention UPF intake still averaged around 50% of total caloric intake suggests that this level of UPF intake does not necessarily preclude success at weight loss. In addition to examining methods of supporting reductions in UPF intake, future research should also investigate whether some types of UPFs may have no effect on (or even facilitate) weight management. Meta-analytic evidence shows that portion-controlled, nutritionally fortified UPFs (e.g., meal replacements) may support caloric restriction and adherence in BWLIs, leading to greater 1-year weight loss [36]. Furthermore, Hägele and colleagues [37] found that high-protein/low-carbohydrate UPFs were associated with lower ad libitum food intake, increased eating rates, decreased ghrelin, and increased PYY compared to normal-protein UPFs. Dietary change is complex and it may be that some UPFs may support adherence to BWLI protocols under certain conditions, such as the use of portion-controlled, nutritionally fortified products. These nuances highlight the need for future research to clarify the physiological and behavioral mechanisms through which UPFs influence energy balance, satiety, and metabolic health.

The present study has several strengths. To the authors' knowledge, this is the first study examining the changes in UPF intake during a BWLI and to examine the unique contribution of UPFs on weight change. Analyses utilized data from a large, randomized trial that first provided all enrolled participants with an evidence-based, gold-standard BWLI. Additionally, the use of validated measures to collect and analyze dietary intake and UPF data strengthens confidence in these findings. Finally, the sample was large and broadly representative of adults who participate in BWLIs and had baseline UPF intake comparable to other studies (our participants reported baseline UPF intake of 53%, whereas other studies have observed intake around 55% [38, 39]).

Nonetheless, results should be interpreted in context of study limitations. First, dietary intake was self-report and thus may be an underestimate of actual energy intake [40, 41]. Although the ASA24 used multiple memory aids (e.g., prompts about potential snacks or drinks) and visual guides for reporting portion sizes, participants may have forgotten some of the items they consumed in the 24 h prior to measure completion or misjudged the amount consumed [42], or due to social desirability bias they might have also selectively reported healthier foods and choose not to report less healthy items (i.e., UPFs) [43]. Second, the current study did not include a control group that received no BWLI; thus we were unable to investigate the causality of the association between BWLI participation and changes in UPF intake. Future studies should be conducted to understand whether interventions can reduce UPF intake and whether this leads to greater reductions in weight. Future studies should also be prospectively designed to allow for investigation into alternative mechanisms (i.e., mechanisms beyond caloric intake) by which UPFs may impact weight regulation. Third, the sample was predominantly female, which may limit generalizability to more gender-balanced populations. Prior research suggests that weight-loss responses can differ by sex [44], raising the possibility that associations observed here may not fully reflect patterns in non-female identifying participants. Future studies should recruit more diverse samples to evaluate whether these associations vary across sex. Fourth, although analyses adjusted for total caloric intake, they did not account for broader dietary composition (e.g., macronutrient distribution), which may also relate to weight change and UPF intake patterns. Finally, the results report only data collected at baseline and immediately after the intervention and thus cannot answer questions about the long-term sustainability of UPF reductions after a BWLI ends. Together, these limitations highlight the need for interpreting the observed associations cautiously and for future trials designed to isolate causal pathways and evaluate long-term behavioral and metabolic outcomes.

5 | Conclusion

Results demonstrated that UPF intake decreased in participants completing a BWLI and that this decrease was associated with greater weight loss. These findings add to the growing evidence of a relationship between UPF intake and weight regulation, but they should be interpreted cautiously given small effect sizes. Future studies might examine whether developing BWLI components specifically focused on decreasing UPF intake supports reductions in UPF intake and ultimately improved weight-loss outcomes.

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Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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